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ANNUAL INVESTIGATIVE REPORT FOR 1927

AND

PLANS FOR 1928

INTERMOUNTAIN REGION

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(PART I)

FOREST AND RANGE RESEARCH IN THE INTERMOUNTAIN REGION

(Prepared by the G. B. E. S.)

The range and forest investigative work now being carried on by the Forest Service in the Intermountain Region comprises four major lines. These are (1) range research by the Great Basin Station, (2) administrative range projects, and, (3) the administrative forest management projects conducted by the administrative field force under technical direction of the District Office and (4) fish and game management studies by the forest personnel in cooperation with the Office of Lands.

Only the work by the Great Basin Station is paid for from special research funds. This work deals with some of the broader problems in range improvement, maintenance and use and the relation of grazing to watershed protection.

The administrative grazing projects are, in the main, observations and studies for the purpose of answering local questions in the application of approved methods of range management.

The forest management projects are chiefly growth and yield studies for ascertaining better information than is now available for application in the preparation of management plans pending the time more comprehensive data are available. Other forest management studies include reforestation, utilization and the effect of grazing on conifer (chiefly western yellow pine) reproduction. The latter is a dual forest and range management project.

One of the chief values of the administrative projects, in addition to the information they will yield, is the training and closer contact with forest and range problems they will afford the administrative personnel.

The Land Use Problem in the Intermountain Region

It is desirable, before discussing the progress and plans for investigative work in forest and range problems in the Intermountain Region, to present a brief review of the whole land use problem in the area involved. Such a review will afford a background to a better understanding of the problems involved, the extent to which they are being studied and the inadequacy of the present research program. While the problems have been more or less generally recognized for a long time and considerable work has been done on several of them, it is only

recently that much thought has been given to outlining a complete program for their solution.

Land Use

The Intermountain Region comprises the territory bounded approximately, by the Salmon River of Idaho on the north, the Grand Canyon of the Colorado on the south, the east slope of the Sierra Nevada Mountains on the west and the 109th meridian on the east. Climatic conditions, natural topographic barriers, geographical lines and transportation facilities, set it apart as a region with many common problems requiring local study for solution. Its land area is approximately 185,000,000 acres or about 1/10 the area of the continental United States. About 20,000,000 acres or 11 per cent is semi-barren and waste and of little or no value except for occasional scenic attractions. The production of cultivated crops at present is confined to 5,500,000 acres or about 3 per cent of the total. The tilled area will probably never be more than doubled on account of unfavorable climate, limited water for irrigation, steep topography or poor soil. The balance of the area- approximately 154 million acres, or 84 per cent of the total - is valuable chiefly for its native crops, timber and forage and for its water supply. The major portion of the tilled land is now and will continue to be dependent on a supply of water for irrigation which comes from high mountain watersheds as does the water used for hydro-electric power and domestic purposes.

The principal industries, exclusive of mining and related industries, are farming, beef cattle and sheep production, the manufacture of farm products, and lumber manufacture. A more recent and growing activity is the development of the recreational resources, based upon extensive scenic, fish and game and other outdoor attractions. The continuation of practically all of the present, as well as any future increased development of these industries and activities, except mining, is influenced by or dependent upon the manner of protection, development and use of the renewable or maintainable natural resources, chiefly native forage and timber, of the wild or uncultivated land. Any use that lowers the yield of products will eventually destroy the value of the land as well as dependent industries. Highest development will come only with a manner of use of the land that will result in sustained yield and efficient use of the products. Such methods of use have not been developed.

Watershed Protection

The water supply, so indispensable for irrigation, domestic use and hydro-electric power, comes from the high mountain watersheds mostly covered by timber or by vegetation of value as forage. Although the greater or lesser destruction of this plant cover by fire, unwise grazing or lumbering practice or other cause, probably would not render the water supply entirely useless, it would seriously interfere with its most effective use by causing greater irregularity of stream flow. Runoff from melting snow in the spring would occur during a briefer period and would be followed by diminished streamflow the rest of the year.

Two other watershed problems can not escape recognition. First is that of the desirability of maintaining the most satisfactory cover of vegetation, particularly of forest on all potential forest sites, and grass, brush and weeds on the remainder, on all sloping lands, as a measure of protection against floods and unregulated runoff and their evil consequences. While the maximum cover that may be maintained economically may not serve to prevent floods entirely, there is no doubt but what such a cover will reduce the damage and at the same time keep the land productive. Several disastrous floods in Utah in recent years are traceable in part to depletion of the vegetation on watersheds, which, if intact, might have abated the most destructive part of the flood crests. This phase of watershed protection necessarily must be extended beyond the limits of the main water supplying areas down on to the lower slopes with low precipitation, but where the rainfall frequently occurs as torrential rains of high flood potential.

The last and probably most fundamental phase of the watershed protection problem is the prevention of erosion. Therein lies the key to the maintenance of soil fertility upon which is based the maintained production of the forage and timber crops as well as the plant cover for watershed protection itself. The soil fertility problem on wild lands involves in part, the return to the soil of an adequate amount of organic material produced by the plant crop to restore the elements removed by that crop. However, the main feature of the problem is the prevention of abnormal erosion which removes the plant nutrients faster than they can be accumulated in the soil.

Depletion of the soil on grazing land is not taken seriously by many people because there are relatively few instances where extensive depletion stands out as an impressive thing. However, the western semi-arid region, largely valuable for grazing because it is not good enough for anything else, has been used for but a relatively short period - not to exceed 80 years, which is not a very long time in comparison with the time it took for the soil to be built up. Because of low rainfall and consequently slow weathering of earth materials and sparse plant growth, the soil is not deep or especially rich. It is easy enough to observe the erosion that takes place on overgrazed or otherwise more or less depleted areas. It is not so easy to observe what is taking place on the areas where mild sheet erosion only is occurring. It is not known to what extent replacement by weathering and decay of organic matter is keeping pace with removal by erosion or otherwise. If replacement is occurring, which for extensive areas is doubtful, no problem exists. If not it would only be a matter of time until large areas will be reduced to a waste, recovery from which will take unknown time. The gravity of this problem urges early study regardless of what may be the case. The risk is too great not to know more definitely what is occurring. It should be possible to prevent abnormal wasting away of soil by one hundred per cent by maintaining a natural plant cover.

Another destructive phase of the erosion problem is removal of the soil and other earth materials from the slopes where they belong and their deposition on other lands or places where they become a menace. Silting up of reservoirs, clogging of streams and deposits of debris on farm lands, are examples of damage by erosion which may be best controlled by maintaining the plant cover.

RANGE MANAGEMENT

Approximately 154,000,000 acres of land including privately owned and state lands, National Forests and other reservations and the open public domain are valuable for grazing. This includes watersheds and about 15,000,000 acres of open timber lands.

Range livestock in the Intermountain Region number approximately 1,284,000 beef cattle and 5,700,000 sheep, (U.S. Census 1925). The total capitalization of the industry including livestock, range lands, equipment, etc., approaches a quarter of a billion dollars. In 1926 this industry produced a gross income of more than $50,000,000. Approximately 80 per cent of the annual forage requirement for the livestock is supplied by native range and pasture.

Range livestock production has already reached its peak unless range conditions are improved and more efficient methods of range use are developed. The public domain range of which there are about 100,000,000 acres, and which furnishes approximately 50 per cent of the forage, has been depleted by 50 per cent or more of its original productivity. Much of the National Forest range is in prime condition while on some areas it is as much as 25 to 35 per cent below what it was originally. Privately owned ranges, in the aggregate, are considerably below their original carrying capacity. In spite of a doubling of hay and feed production, a large increase in the acreage of improved irrigated pastures of high carrying capacity, the opening of new range by water development and other improvements sufficient to offset the range area that has passed under cultivation, a slightly higher efficiency in the use of available forage, and a general tendency toward more feeding of corn, cotton seed products, and other imported feeds the last 20 to 25 years, the livestock population is not as great as it was in 1900.

Maintaining the present productivity of forage on the range or any increase to restore them to their original value, and at the same time obtain the fullest economical use of this crop, will require the application of better methods of range management and use than are now practiced, as well as the fullest application of all possibilities in artificial reseeding. Already the deterioration on the open public domain has depreciated the value, in many places, to a point where livestock producers figure the land would not return taxes and interest if privately owned. Although some system of control that will permit regulation of grazing on this area is essential for the application of better range management, the necessary practice to properly handle them have not been worked out. Ranges already under control may be saved

from further injury by curtailing the number of livestock grazed, but sound economics requires that they be made to contribute to the fullest extent to maintaining industry. Some progress has been made in better use of the high summer ranges but the possibilities of maximum production and full efficient use lack a great deal in having been worked out.

Although range management must deal primarily with perpetuating the yield of the forage crop, and an ample forage supply will continue to be the basis of sustained livestock production, attention needs to be directed also to more efficient use of the forage produced. In other words, the most economical production of meat and wool for each unit of range must not be overlooked. Crops of lambs and calves are much lower and losses from starvation, parasites, disease and other causes are much heavier than what may be considered reasonably efficient. This is largely the result of poor range practice and inadequate nourishment of the animals due to overstocking the range and inadequate feeding during the late fall, winter and early spring months. The outcome is not only low returns from the industry, but a great deal of the forage - that utilized by the non-productive animals - is literally wasted. The opportunity lies ahead of developing a more efficient system of range utilization and livestock management that will result in high production from fewer breeding animals for each year-round range unit.

FOREST MANAGEMENT

There are approximately 20,000,000 acres of timber land including commercial stands, young and immature timber, cut-over and burned-over areas and protection forests in the Intermountain Region. The present gross stand is estimated at approximately 40 billion board feet of saw timber, 16 billion feet of immature timber and 20 million cords of cordwood with a gross value of more than $82,000,000 aside from the value of the land, logging equipment, sawmills, etc. In Utah the stands are largely second growth, all readily accessible areas having been cut over during the early development of the state. Extensive virgin stands still exist in Idaho, Wyoming and Arizona. This timber resource, if adequately protected against fire, insects, disease, and other destructive agencies and if properly managed, is capable of supplying the timber needs of the Intermountain Region and possibly in addition, a small supply for export. Most important of all, this resource can maintain an industry of considerable size. These lands are more valuable for the production of timber, in addition to furnishing a water supply, than for any other purpose and any loss in productivity is just that much loss toward the fullest development of the region.

Keeping the timber lands fully productive will require better methods of timber protection and timber growing and more efficient utilization of timber than have been developed so far. In spite of every effort, fire, disease and insects take a heavy toll each year. Thoroughly reliable silvicultural methods have not been developed for the conditions in the region. Experimental phases of reforestation have not been completed. Utilization has not been developed to make the most economical use of forest products. Practically all phases of forestry are in the pioneer stage.

Essentials of a Research Program

The whole land use problem involves the development of methods of protection and use of wild or uncultivated lands that will -

1. Insure the maintenance and full development of those industries utilizing the water supply for irrigation and hydro-electric power, provide an adequate domestic water supply and afford the fullest possible protection against floods and other damage caused by sudden runoff and abnormal erosion; this to be accomplished largely through the protection and regulation of use of timber and forage but requiring the facts regarding the relation of plant cover to the water supply and the conditions of ground cover that will insure the optimum water supply conditions.

2. Make full use of approximately 80 per cent of the land area of the region for the production of timber, forage and associated resources, in accordance with the requirements of the water supply, in order to maintain and extend the existing livestock, timber and subsidiary industries, to supply as much as possible of the wood and other forest products for local and national needs, and to afford the necessary health and recreation for the people provided by hunting, fishing, outdoor life and scenery upon these lands.

To make full use of the 80 per cent of the land area will require:

a. In Forest Management

1. More efficient methods of protecting forest lands against fire, insects, disease, animals and other destructive agencies.

2. A satisfactory silvicultural technique or manner of cutting and managing timberlands that will insure the highest yield of timber on cut-over lands and lands ready for cutting and the determining of suitable planting methods on lands best adapted to timber growing but where unsatisfactory forest growth occurs at the present time.

3. More efficient methods in the manufacture and utilization of wood.

4. Detailed information of an economic character concerning such matters as timber supplies and requirements, price trends and taxation.

Undoubtedly a great many of the principles worked out elsewhere, under headings 1 and 3, could be successfully applied in the Intermountain Region but even then it would take considerable study to apply them to local conditions. Moreover phases of these problems peculiar to the region would have to be worked out completely.

The information under headings 2 and 4 will have to be worked out largely under local conditions. The reasons for this for item 4 are obvious. Seed production, the establishment of reproduction, rate of

growth, and other silvicultural requirements are dependent upon climate, soil and other factors so purely local that results in other regions would require rather complete modification for local application.

b. In Range Management

1. The development of satisfactory methods of grazing that will restore the native forage plants on the areas that have been more or less depleted and will insure the maintenance of the maximum grazing capacity in perpetuity, and the development of forage plants and methods of planting for the restoration of badly depleted areas and the improvement of the native forage stand.

2. The working out of more efficient methods of range utilization to prevent waste of forage and afford the use of the feed that will bring maximum crops of calves and lambs, maintain the most rapid growth and gains of the livestock raised for market and to avoid serious forage shortage and excessive use of high priced supplemental feed in years of sub-normal growing conditions.

3. The development of methods of grazing that will prevent injury to timber reproduction, watersheds and other resources and at the same time avoid undue waste of forage through nonuse.

All of these are problems for which the solution may be found only by accident, experience or research. Discovery of the solution of the problem by accident is out of the question. The method of experience is slow, expensive and not thorough. Research, which has contributed so materially to progress in all other lines of industry and social welfare, is the most reliable method of obtaining the information needed for solution of these problems.

(PART II)

PROGRESS IN RANGE RESEARCH DURING THE YEAR

(Prepared by the G. B. E. S.)

General

The District Investigative committee met in 1927 on January 3 and 4. The time of the Station personnel for the remainder of the winter until April 28 was devoted to compilation and some analysis of data. Nelson spent a large share of his time on a report on work that he did while on the Jornada Range Reserve. Compilation of Station data was materially facilitated by the assignment to the Station by the District Office of two junior foresters, - Bert Lexen and Ed Ritter, - for a little over six weeks each, and sufficient funds to hire an assistant compiler, - G. D. Pickford, for three and a half months. With this assistance it was possible to get most of the preliminary compilation up to date. The field season of 1927 closed on October 30 and the time from that date until the holding of the Investigative Committee on February 27, 28 and 29, 1928, also has been devoted to compilation of data. Nelson left on February 1 on a 3 months' detail to Washington to further pursue the Southwest work so that the time for this period, again, will be lost to the Station. District 4 has helped again by assigning an assistant compiler to the Station for about three months. Most of the preliminary compilation of field data should be up to date by the beginning of the field season in 1928.

Field work progressed in good shape during the season from April 28 to October 30, 1927. The regular Station force consisted of the Director, Mr. Nelson, Mr. Mann and one field assistant - Mr. E. V. Staker, a graduate student of the University of Minnesota. This was augmented by the assignment of eight men to the Station from other organizations for training purposes. These men and their periods of assignment were as follows:

Trainee	Organization	Period	Days
Dr. Geo. Stewart	Utah Agri. College	June 11-July 11	30
F. G. Renner, Range Exmr.	Wenatchee N.F.	July 4 -July 30	26
O. A. Harrison, F. R.	Wyoming N.F.	July 6 -July 30	24
J.W. Farrell, Asst.Sup.	Idaho N. F.	July 6 -July 30	24
Fred Stell, Range Exmr.	Montezuma N. F.	Aug. 1 -Aug. 31	30
A. G. Nord, For. Sup.	Ashley N.F.	Aug.17 -Aug. 30	13
O. S. Murie, Biologist	U.S. Biol.Survey	Aug.26-Sept. 19	24
F.C. Koziol, Asst. Sup.	Weiser N.F.	Sept.9-Oct. 2	23
Total 8			194

With this assistance it was possible to carry forward all of the field work planned. Although a fair share of the regular Station personnel was taken up with starting and working with the trainees,

there was a net gain of approximately one half the 194 days in accomplishment by the Station.

There are two outstanding deficiencies in the Station work under way at the present time, both of which could be materially remedied by the assignment of an additional yearlong assistant to the Station. They are the strengthening of the field work in a few places, but more especially the spring-fall range projects at the Sheep Station, and bringing the analysis and preparation of reports up to date. Ground is being lost in these two phases each year and there appears to be little hope of catching up until the field work in some of the other projects can be materially reduced.

At the present, the Station has a very heavy schedule of projects for the size of the force. Work actually started is more than can be carried satisfactorily, without attempting to fully round out any of the projects. The spring-fall range work which is in cooperation with the Bureau of Animal Industry has never received the attention it requires by the Forest Service. It should have the time of one man for not less than 8 weeks a year. The other work of the Station could utilize his services for the rest of the field season, to excellent advantage, in carrying the present projects forward without any expansion whatever. Such a plan would make more of the Director's and Nelson's time available for analysis of material and preparation of reports as well as make some of the additional man's time available for the same purpose.

Status of Analysis and Reports

At present, the erosion and streamflow projects, the management of browse range and artificial reseeding are pretty well up to date except as a little more time will be needed to push along the three manuscripts on these projects. Data on other projects that have never been worked up and thoroughly analyzed are now available as follows:

Climate and Plant Growth: Fourteen years records of principal climatic factors at three stations, supplemented by Weather Bureau records for other stations, with information on plant development and growth for correlation with climatic data for seven years are now available. A report on a special phase was published in 1918 (Bul. 700) but the general data have not been analyzed.

Natural Revegetation: (Improvement and Maintenance). Plots and quadrats under different conditions, some established as far back as 1914 and some more recent plots, have been kept up to date. Various phases have been reported on from time to time but all the data have never been fully analyzed up to the present time.

Period Study: (A part of Natural Revegetation Project). Preliminary work up to 1922 inclusive has been summarized and published. Further observations and checks have been carried forward to date but have only been partially analyzed.

Plant Vigor: (A part of Natural Revegetation Project.) Preliminary data up to 1922 have been worked up and published. Further studies and extension of project to actual grazing conditions have been carried on since 1923, but the data have never been completely analyzed.

Characteristics of Cell Sap of Range Plants: (in cooperation with Dr. Harris, Univ. of Minn.) Various determinations have been made for the cell sap of range and other plants in the vicinity of the Station for four years, and several more years data are available for adjoining areas, which have never been analyzed or reported upon.

Management of Spring-Fall Range in Idaho: This project was started in 1923 and has been carried forward to date. The data have been only partially analyzed.

Just how much of the available material is ready for final publishing, can not be determined until it has all been worked up. However, some of it has reached a point where definite conclusions may be reached. Other projects have reached a point where progress reports could be published. Information on certain phases of projects could, no doubt, be worked into worth while articles. All of the material should be analyzed up to date for use by the Station in directing its work in the future.

Range Management Manual for Intermountain Region: Someone ought to be working on bringing together all of the available tested information on range management for the Intermountain Region for publication as a circular for use within the region. Now, all of the information is scattered through a number of publications and is pretty general in application. There is need for bringing all of this material together under some such title as "Range Practices for the National Forests of the Intermountain Region" for use locally. This is a job for the Station, whenever it can be handled.

The reason for this arrears in analysis and preparation of reports is not difficult to trace. In the first place the Station has a very heavy program of projects. Unanalyzed data have been accumulating gradually since 1914. This has been augmented by Nelson spending a lot of his time each winter the last three years on a similar hangover from his previous assignment. Nelson has done a lot of work in directing compilation and doing preliminary analysis of the G.B.E.S. data but has not had time to press any analysis through to the end. Then also more and more of the Director's time is being taken up with various phases of the Station work other than analysis, etc., of data. The only way out of the situation the Station has in its power is to cut more and more into the field work and thus make more time available for working on the reports, but this will be a slow process. The assignment of another man to the station would be the most desirable way out. Plans for 1928 are for both the Director and Nelson to push analysis of data as far as possible during the field season.

Progress in Projects

Climate and Plant Growth

The weather -- "which always varies and is impossible of foretelling, but which never altogether reverses or departs from the records of the past" is generally considered as one of the factors beyond the control of the range livestock producer or the administrator of range lands. Range management is troubled and confounded by vicissitudes of climate entering in to upset or make uncertain the normal carrying capacity. Perhaps no one factor has been so influential in causing the ups and downs in range livestock production over a long period of years. Range history is replete with records of extremely heavy losses and even the wiping out of livestock enterprises caused by drought, severe storms or other weather reverses. Usually these losses are coupled with a shortage of range feed. Gambling with the weather has come to be considered as one of the unavoidable risks of the industry.

The weather can not be foretold or controlled. The problem must be met from another angle; at least that is the assumption being followed in the study of this problem. It should be possible to ascertain for different localities the amount and frequency of these ups and downs that may be expected and insofar as possible the provisions that may be made to meet them.

Records now available indicate that the volume of forage produced on mountain summer range in Utah and on spring-fall range in eastern central Idaho may vary as much as 30-37 per cent above and below average one year with another. The years 1924 and 1926 were extremes below normal while in 1925 production was abnormally high. A study of rainfall records in the upper Snake River region of Idaho indicate that a dry year may be expected approximately once in every four years.

Results in 1927 bear out previous observations on high range in central Utah that an average or above average forage crop is assured in that locality if moisture conditions are favorable during the month of June.

Observations over a period of years indicate that the deficiency in quantity of forage in unfavorable years is offset to some extent by a higher quality as compared to the quality of the rank growth in wet years. A combination of favorable conditions such as in 1927 result in a large quantity of forage of high quality. In those years of copious rainfall throughout the growing season, as in 1925, a rank growth of the forage occurs. This forage is not so palatable as the less rank growth, probably because of a higher fiber content, and does not mature well for late summer grazing. Moreover, much of rank growth is trampled down when first grazed and is wasted. In the years with less favorable growing condition the growth is less rank, the palatability is higher, less of the forage is trampled down and wasted and the feed matures better. This may account for the fact that stock come off the ranges in almost as

good condition and shrink less in shipment in dry years than in the years of abnormal growing conditions, in spite of the fact that the animals on heavily stocked areas run out of forage before the end of the grazing season, in the dry years. Thus there appears to be a compensating effect between the greater forage production in abnormal years and the deficient quantity produced in poor years. Nevertheless, the high quality of feed in subnormal years is not adequate to offset the shortage of feed in such years and the dry year factor must be taken into account in determining the normal carrying capacity. Moreover, the poorer quality in years above the average may not actually afford as much of a higher carrying capacity in such years as is often supposed.

Conditions were favorable for a slightly abnormal production in quantity of forage of high quality in 1927. Growing conditions were unusually favorable during the forepart of the season (June and July) and a forage crop 7% in excess of average quantity was produced. Following July there was less rainfall than average and the vegetation matured into forage of high quality.

Artificial Reseeding:

Work in this project for 1927 was confined to starting several trials with yellow and white sweet clovers and crested wheat grass. The seed of these species was furnished by the Bureau of Plant Industry. Crested wheat grass, a species originally imported from the Steppes of Russia, has shown fair promise in early tests in the Great Plains Region. Spring and fall sowings made in the oak brush belt (elevation approximately 7,200 ft.) at the Great Basin Station. Several methods of soil treatment were used including sowing on the surface with no treatment, sowing and harrowing, plowing furrows about three feet apart followed by sowing and harrowing, and sowing and harrowing on plowed ground. The sweet clover seed was not scarified or inoculated. The presence of Vicia, Astragalus and Lupine on the area would indicate the soil is already supplied with nitrifying bacteria. Fair stands were obtained in some of the spring tests with the sweet clovers. Crested wheat grass made only a thin stand the first year.

Natural Revegetation (Range maintenance and range improvement)

Work for the year consisted of remapping all of the quadrats and relisting the major plots due for rechecking in 1927. Work was extended to the earlier range in the oak zone, during 1923 to 1926. No new work was undertaken in 1927.

Range in the right hand fork of Ephraim Canyon which is supervised by the Manti National Forest in cooperation with the Station as more or less of a demonstration area, has improved materially since 1922 where the soil was not depleted and a seed supply was available. The construction of a drift fence to keep cattle from the range until vegetational readiness, and some reductions in the numbers grazed following exchanges on a ration of 2.15 sheep for 1 cow for a comparable

season, have made possible management to improve the range. One area (Bluebell Flat), where the soil had not been eroded and where seed was available from grasses and other plants on a nearby slope, is rapidly changing from an almost pure stand of Pentstemon rydbergii to a cover of Bromus polyanthus, Agropyron violaceum, Stipa lettermani, Melica sp. and weeds. The invasion of Rudbeckia occidentalis presents another problem on this area. Another tract (near the Dungeon) is being invaded principally by Agropyron violaceum and Stipa lettermani. Still another area (Second Bridge Flat) which has an undepleted soil, is not improving rapidly, apparently because of the absence of a source of seed. Some Bromus polyanthus seed was sown on this area in 1927. Range at the higher elevations where the soil was badly depleted by erosion prior to 1910, is improving very slowly; many such areas now show definite indications of passing from the first weed stage to the early phases of the second weed stage.

The need for a more exhaustive study of the soil is becoming more apparent each year. The properties of the soil, including the physical, chemical and biological phases have a powerful influence on plant succession both on depleted ranges and on areas of high productivity. Observations in 1927 by Dr. Geo. Stewart, Agronomist of the Utah Agricultural College, indicate a close relationship between character of the soil and range recovery. An informal cooperative project was undertaken with Brigham Young University in the fall of 1927, to study the chemical and physical properties and bacteriological and other minute life organisms in soils of different degrees of productivity. These preliminary studies will undoubtedly afford leads for further studies of soil problems, a knowledge of which are essential for a proper understanding of most all range problems.

The study of soils should be pointed particularly toward the effect of forage utilization and erosion on soil fertility. There has existed for many years more or less of a popular opinion that under grazing use of range land, sufficient organic material is returned to the soil to maintain fertility. Pasture studies in some of the eastern states where conditions should be as favorable as anywhere for sustained productivity of the soil, however, are indicating more and more the need for the addition of fertilizers. Maintenance of soil quality may be provided for on range areas where erosion is not above normal and where a considerable portion of the annual plant crop is left on the ground, either in the form of unpalatable vegetation or unutilized forage, but on closely used ranges or wherever abnormal erosion is occurring it is doubtful that rehabilitation of the soil is taking place. Nitrogen content, in particular, is important. Some information indicates that leaving the coarser parts of plants, such as stems of grasses and weeds, may be of little or no value for soil improvement because the soil bacteria may use all of the available nitrogen in breaking down such material and leave but little of this element for plant growth. Maintenance of fertility of range soil is largely a problem of preventing erosion and leaving sufficient vegetation to go back to the soil since manuring and other means of fertilizing are prohibitive in cost.

Rodents, including squirrels, gophers, rabbits and mice constitute another detrimental factor in range improvement and maintenance. For example in 1927 it was observed that rodents destroyed 75 to 90 per cent of the seed crop of certain grass species on overgrazed range left to reseed. Damage consisting of cutting the seed stalks several inches above the ground occurred shortly after the seed has formed and before it was ripe. Destruction of seed in this manner is quite a problem on ranges where only scattered specimens of desirable forage plants occur to form a nucleus for range reseeding.

Period Study

Work in this project since 1922 has been confined to further study of the time when vegetational readiness occurs at different elevations and in different years, to a check of what stage of development constitutes range readiness and to determine the possibilities of alternating early use one year with late use the next.

Nothing has developed to indicate that an average height of 6" for the more common bunch grasses of the Wasatch Plateau region is unsound as an indicator of range readiness. Four years treatment of mountain brome (Bromus polyanthus) indicate there is no advantage in delaying grazing until 10 days after range readiness as compared to beginning grazing at range readiness (average height 6 inches). There was a material decline in yield when harvesting began when plants had reached only 4" in height, however, as compared to delaying harvesting until the 6" height had been attained. Wheat grass (Agropyron violaceum) yielded less when harvesting began at the 4" height as compared to beginning at the 6" height and a still greater yield of this species was had when cutting was delayed until 10 days after the 6" height had been reached.

Results in tests to compare the effect of early cropping one year with delayed cropping the next year (cropping delayed until six weeks after growth began in one case and until seed maturity the other,) indicate that the vigor of Bromus polyanthus has held up over a period of four years in a manner corresponding to when the vegetation is grazed at vegetational readiness each year but the yield was not as great. Wheat grass held up under this method both in vigor and average yield fully as well as plots cut at vegetative readiness.

The time of the year when grazing may begin on spring-fall range and methods of management that will make possible early grazing at least in some years is receiving considerable attention at the U. S. Sheep Experiment Station. The following table shows the amount of forage produced, in sheep days feed, during four years in several 80-acre paddocks under different methods of use at the U. S. Sheep Experiment Station.

Methods of Grazing	1924	1925	1926	1927	1927 in % of 1924
		Sheep days feed			
P2 Grazed from time growth begins in the spring until end of spring grazing season and again in the fall.	4072	6958	3183	2567	63.0
P8 Grazed from time main grasses are 4-6 inches high until end of spring grazing season and again in the fall.	3849	6641	3297	4171	108.4
P3 Grazed during first 3 weeks of growing season in the spring and again in the fall.	4514	6670	4435	3949	87.5
P1 Grazing deferred until in the fall each year.	4561	7530	4283	5532	121.3
P7 Light use in the spring with very heavy use in the fall.	4685	7347	4714	5612	119.8
P9 Grazed from time of vegetational readiness in the spring - through the summer and in the fall.	3877	6297	4001	4045	104.3
P10 Grazed from time of vegetative readiness in spring and again in fall (not such heavy use in spring as in 8)	3578	6900	3833	4376	122.6

A large part of variation from year to year is due to differences in rainfall. It was very dry in 1924 and 1926. In 1925 rainfall was considerable above normal. In 1927 it was more nearly average. Direct comparison therefrom can not be made of loss or improvement in conditions under different methods of use. However, a comparison of the amount of feed produced in 1927 above or below that produced in 1924 will afford some idea of what has happened under different methods of use.

Areas indicated as P1, P7 and P10 have been wholly or partially deferred each year and have improved more or less since 1923. It will be noted that they produced approximately 22 per cent more feed in 1927 than in 1924. This is due mainly to more favorable growing conditions in 1927 but in part to range improvement. Area P2, however, produced only 63 per cent as much feed in 1927 as in 1924, or only a little over half as much in proportion to what the three areas produced. This paddock began to

"break" in 1926. Under the method where grazing occurred in the spring only during the first three weeks of the growing season, the paddock (P3) produced but 87.5 per cent of what it did in 1924, although it had held up during the three previous years. The paddock grazed closely in the spring beginning after range readiness (P8), produced 108 per cent of what it did in 1924 or considerably higher than the area where grazing started several weeks earlier. Very heavy use in the fall (P7) has had no detrimental effect in four years. (Grazing in this paddock does not occur until after the grass had stopped growing and has cured, where as on mountain summer range, where very close use in the fall appears to be injurious, grazing occurs throughout most of the period the vegetation is growing.) This study, of course, has not been carried on for a sufficient period to warrant any conclusions with respect to the effect of grazing at different seasons of the year. The data presented merely indicate what has happened to date.

Degree of Utilization: (Part of Natural Revegetation Project) A sub-project started in 1925 has as its purpose a study of the degree of utilization various species will withstand and standards for judging utilization. A memorandum report on information obtained to date will be prepared during the spring of 1928.

Plant Vigor: (Part of Natural Revegetation Project) A study of the effect of time and frequency of harvesting several species was begun in 1918. Early work was reported on up to 1922. Various checks on this work have been running since 1922, but this can not be reported upon until the data are more thoroughly analyzed.

Management of Browse Range

Preliminary phases of this project being conducted on the Dixie National Forest are in course of publication. The project was inactive during 1926. Grazing of the area was started again in 1927 for the purpose of obtaining more information on the carrying capacity of browse range.

Effect of Grazing on Erosion and Surface Runoff

Results in this project up to and including 1925 are in course of publication. The project has been continued through 1926 and 1927. Measurements of runoff from melting snow as well as from summer rainfall were made in both years. Watershed A, the variable area, has been grazed by sheep late in September the past two years. This practice will be continued at least three years more. Moderate to light late grazing, is not detrimental to the vegetation and is assisting in trampling seed of the plants into the ground. Watershed B, the check area, was grazed with sheep each year until 1927. Grazing by cattle for a short period was introduced in 1926 and in 1927 no sheep were used. Change in class of stock has been made to check spread of the grasses. Sheep do not graze this class of vegetation closely enough after mid-summer to prevent their reseeding.

Several storms occurred during the summer of 1927 which offerred additional checks on the effect of the improvement of the plant cover on watershed A. The density of the vegetation in 1927 had reached approximately 45 per cent of a complete cover while that on B remains near 40 per cent.

Thirty rain storms occurred on the two areas between July 1 and October 1. Of these eight caused runoff from A and three caused runoff from B. The five storms effective on A but not on B resulted in only a small amount of runoff on A - not to exceed 115 cubic feet in any case. Two storms, those of July 21 and July 27, were torrential in character approaching those of September 2, 1919, and August 13, 1923, in intensity of rainfall.

During the period 1915-1919 inclusive, when only 16 per cent of the ground was covered by vegetation on Area A and 40 per cent was covered on B, there was 7.14 times as much runoff and 8.76 times as much sediment removed from A as from B. In 1927 when there was approximately a 45 per cent cover on A and still a 40 per cent cover on B, there was only 2.01 times as much runoff and 2.52 times as much sediment removed from A. This indicates that the increase in cover on A has brought about a reduction of 71.85 per cent in runoff and 71.23 per cent in sediment removed.

Runoff from melting snow was less in 1927 than in 1926 in spite of the fact that there was less water in snow available to runoff in 1926. The following tables gives a summary of runoff and erosion for the two years:

	Area A		Area B	
	1926	1927	1926	1927
Potential runoff from snow - cu. ft.	433,463	745,703	306,791	436,085
Total runoff " " " "	370,210	324,928	82,398	32,382
Portion of snow water that ran off - %	85	44	27	7
Sediment eroded by spring runoff- cu.ft.	187	103	94	73
Runoff from rain " "	807	14,632	330	7,271
Sediment eroded by rain " "	138	990	22	394
Portion annual runoff from snow - %		95.7		81.7
" " erosion " " - %		9.4		15.6

Difference in the amount of runoff from summer rains, one year with another, are due to differences in amount and character of rainfall. Heavy rainfall during short periods of time cause more runoff than the same amount of water falling over a longer period.

The differences in the per cent of the water in snow that ran off during the two years are due chiefly to the character of the temperature during the melting period. In 1926, for example, the temperatures remained fairly high and melting occurred much faster than the water could be absorbed by the soil. In 1927 melting temperatures were lower, melting occurred slower and more of the water went into the ground. Data, although greatly needed, are not available on the effect of the additional moisture that entered the soil in 1927 on runoff from springs and on the ground water supply.

Observations over a period of years have crystallized the need for an intensive study of factors affecting runoff and erosion under fully controlled conditions. Such factors as character and amount of cover, character of soil, including structure and texture, degree of slope, character of drainage system (gullying), moisture content of the soil and intensity and amount of rainfall can not be studied readily or economically under the present system of using watersheds of 10 acres or more in area under natural conditions. Sooner or later an experiment to study the factors should be started with small, perhaps adjustable soil tables of proper size, upon which all factors, including an artificial rainfall system, could be controlled.

Plans for 1928

Field Work

The aim will be to confine field work to recurrent record taking in each of the projects during the field season. No new projects will be undertaken. An effect of burning on range forage project was approved last year but can not be undertaken until more field time becomes available. A study of a site for this purpose may be made in 1928 if time permits.

The field season will be started in time to obtain plant development records on low range from the time the snow melts and to obtain records on runoff from melting snow in the erosion and runoff project if snow conditions are unusual this year.

Work on the Dixie browse study will be limited to the grazing of the cattle as in 1927 under the direction of the local forest officers, with one or two trips to the area by Station men to obtain records on utilization.

Two or three trips will be made to the U. S. Sheep Experiment Station for check up on that work.

A ten-day to two-weeks trip will be made to the Boise National Forest in September to study the erosion situation on granite soils.

Assignment of Trainees:

The program of assigning forest officers to the Station for periods of about a month will be continued through 1928, with not to exceed eight men during the season.

Meetings:

A ranger meeting of the LaSal, Fishlake and Manti Forests will be held at the Station the first week in August.

A Field Day will not be held at the Station in 1928 unless sufficient pressure is brought to bear by stockmen and others that it be held. Several such requests have already been received. If held, it will be between the 12th and 18th of August.

Probably no Field Day will be held at the U. S. Sheep Experiment Station until 1929.

The Director has agreed to conduct a course at the Uintah Basin Industrial Convention again in 1928. This meeting will be held during the week of August 6 to 11.

Reports and Publications:

Reports and publications will be pushed along as rapidly as personnel and time will permit. Those on the waiting list are:

1. Natural Revegetation
2. Climate and Plant Growth
3. Spring-fall range studies
4. Cell sap studies
5. Plant vigor
6. Grazing Practices for National Forest Ranges of Intermountain Region.

(PART III)

ADMINISTRATIVE RANGE MANAGEMENT PROJECTS

(Prepared by the Office of Range Management)

Following is a summary of the administrative range investigative activities being stressed in District 4, a brief review of the work done on these activities during the past year, and an outline of the work to be done in the near future.

Study of Range Revegetation

Studies have been under way for a good many years in District 4 to obtain more reliable information than can be obtained by general observation on whether the range on the National Forests is improving, deteriorating, or standing still. Changes are usually so slow that they can not be detected from year to year and definite records are needed. This work as now carried on consists of obtaining records by the quadrat and major plot methods on grazed range supplemented by similar records on protected enclosures. Some enclosures have no quadrats and are used for direct ocular comparisons. Until a few years ago, this work was done exclusively by technically trained grazing men. The last few years it has been extended considerably and made a ranger activity, with help and direction from the supervisors and District offices.

Quadrat Work

More or less quadrat work has been done in the National Forests in District 4 for the past fifteen years. Men especially qualified in this line of work, usually working out from the District Office, have given personal instruction to the field men. Discussions and demonstrations of quadrat work have been an important part of all Rangers' and Supervisors' Range Management field meetings during the past three years. The past year technically trained men have given personal instruction in quadrat charting to 20 rangers, 2 supervisors, 2 assistant supervisors and 5 field assistants, in addition to the instructions given at one Supervisors' meeting, at which half the supervisors in the District were present, and at two ranger meetings, at which the rangers from six forests were present. It is believed that now practically all administrative officers in the District have been given preliminary instruction. Instruction will be continued as rapidly as the men and time available will permit. Grazing survey men helped other forest officers chart quite a number of quadrats and charted nine alone during the past season. Many quadrats were charted by rangers throughout the District. During the coming summer it is planned to have a man from the District Office rechart some of the quadrats on the Minidoka, Cache and Uinta National Forests, and compile and analyze the data. Thereafter it is planned to turn all of the quadrat work over

to the various forests, except to such extent as the District Office can aid as opportunity affords.

During the past year the Office of Operation supplied the forests with enough iron to stake over 1400 quadrats. All, or practically all, rangers have quadrat straps. New instructions for doing quadrat work have been prepared, and a system for compiling and analyzing quadrat data has been worked out which will appear in the Range Management Section of the Handbook which will be ready for distribution in the near future.

In a discussion in the District Investigative Meeting on ranger quadrats, it was pointed out that one, or a few, quadrats cover such small areas that they should not be expected to give accurately all of the changes that might occur on large units of range. We cannot hope to have enough quadrats established to check on the changes on all of the range areas. Quadrats should be placed on areas where they will give the most useful information and should be located so they will represent the area around them as well as possible. Because quadrats cover relatively very small areas, because it is hard to choose proper sites, and because errors might creep into the mapping, the data gathered from quadrats should be used with judgment and careful consideration of all factors that might enter in, in determining range conditions. The importance of careful planning for quadrat work and careful selection of sites for their establishment cannot be over-emphasized. A plan should be drawn up for each ranger district and the number and general location of each quadrat decided.

Major Plots

Lately some use has been made of plots from one to several rods square for the purpose of studying changes in the vegetative cover. These major plots have been adapted to the study of one, or a few, important species. For example, it may be important to know if some species, such as bluebell (Mertensia sp.), niggerhead (Rudbeckia occidentalis), Senecio serra, or blue bunch wheatgrass (Agropyron spicatum) is increasing or decreasing on a certain range area. In such cases a plot, a rod or two square, can be staked off, and the individual plants of the species to be studied inside the plot may be counted. A recount isthen made a few years later to determine increases or decreases. It is planned to urge the establishment of a limited number of such plots where there is a special need for them.

Experimental Enclosures

The District is still actively engaged in constructing and studying experimental enclosures on the ranges. Recently the Office of Operation sent 1600 rods of woven wire to the field to be used in constructing and reconstructing these enclosures, and enclosures to study injury by grazing to timber reproduction, mostly for the former. New forms will be sent to the field for the purpose of keeping records on

the experimental enclosures. The Office of Range Management is co-operating with Forest Management in the work of establishing enclosures for study of effect of grazing on timber reproduction. A total of 745 quadrats and 510 enclosures have been established to date, on the forests in the District.

Plant Development Records

Plant development records are being kept for all important types of range for the purpose of determining the proper opening date for the grazing season and the variation in the time of vegetational readiness. This is purely a ranger activity. New forms and instructions were issued by the District Office during the past year and considerable personal instruction has been given to the field men. However, this work is not so difficult as quadrat work and rangers do it very well without personal instruction. This work has been received very favorably by the field officers and considerable work is being done. Practically every ranger has established sufficient plots to secure what he believes to be representative conditions.

Individual Allotment Records

Individual allotment records are now being kept on most allotments for use in determining carrying capacity more accurately.

Learning to Know Plants

It is considered very important that forest officers know the names of range plants, at least the more important ones. As an aid to the men in learning the names of plants, 85 dissecting sets and hand lenses are being purchased for the forest officers who seem to be best prepared to make use of the outfits. A representative of the District Office gave personal instruction in the use of botanical keys to 6 supervisors, 2 assistant supervisors, and 19 rangers during odd hours the past year. There is much activity in the collection of plant specimens for identification. Eighteen new plant presses have been distributed to the field during the past month and now practically all rangers have access to plant presses. A total of 8018 plant specimens have been identified and filed in supervisors' offices and 3423 more have been collected but not identified. As many as possible of the latter will be given tentative identification by the District Office.

A list giving the correct scientific and common names for the more common and important plants throughout the District has been prepared, a copy of which will be given each forest officer. It is believed this will be an aid in learning the names of plants and will help to standardize common names.

Palatability Studies

As an aid to the field men in a study of the palatability of plants, a form that will fit the Form 874-C binders is being supplied field officers, for recording the palatabilities of plants separately for C&H, S&G, and common use range, for spring, summer and fall. It is believed that palatability studies can be made in connection with other work, and will give valuable information, and valuable training to the men who make the study.

Utilization

Much discussion in the Investigative Committee meeting centered around a definition proposed at a Range Management field meeting last summer for studying and expressing utilization. Some changes were made in the definition and it finally was accepted in the following form:

Individual Species:

When the leaves and new twig growth within reach of stock have been taken from shrubby plants, they will be considered one-hundred per cent utilized.

When herbaceous plants have been grazed down to the ground these plants will be considered one-hundred per cent utilized. An exception will be made in the case of niggerhead, Senecio serra, and some other species with tough coarse stems. When the leaves, side branches and the end of the main stems of such plants have been fully grazed, they will be considered one-hundred per cent utilized.

Units, Allotments and Ranges:

In considering utilization of groups of plants, on units, allotments, and ranges, as in range inspection work, the following definitions will be used:

The per cent of utilization on the unit, allotment, or range, will be considered an average of the per cent of utilization of from three to six of the important palatable plants of greatest abundance.

To insure perpetuation of the most important forage plants, they should be not more than 80 per cent utilized during the season.

In the application of the above definition of utilization several points, not wholly covered in the definition, should be kept in mind. In a study to determine how much of a given species has been utilized, judgment should be based on the average utilization of that species. Ordinarily the per cent of utilization of each species at the end of

the grazing season will represent the percentage of palatability of that species under the degree of stocking, class of stock and other conditions existing on that particular area.

In deciding upon the utilization on units or range, care must be used in selecting the species upon which judgment will be based. Obviously on a range well stocked with an abundance of good, palatable species one should not plan to stock the range on the basis of perpetuating one or a few extremely palatable plants that are not abundant when to overgraze these few "ice cream" plants would mean getting more full, but not too full, use of plants that are both abundant and palatable. On the other hand, ranges may be in a depleted condition and need building up. In such cases it will ordinarily be necessary to base stocking on the perpetuation, and therefore not too full utilization, of species that are not abundant, but are important because they are the plants that will make a dense, palatable forage cover if allowed to become vigorous and reseed. Similarly on ranges where the bulk of the forage consists of a less palatable species, as oakbrush, but which are not necessarily depleted, it will be desirable to base stocking on more palatable but less abundant species, such as birchleaf mahogany, bitter brush, grasses and weeds. These and other questions must be carefully considered in deciding which are the species to be perpetuated and which, therefore, are to be observed in arriving at the per cent of utilization on the unit being studied.

It is not possible to set up an arbitrary figure to be used as a standard of utilization of ranges, as there is considerable difference in the per cent that different species and combinations of species can be utilized and still remain vigorous. Such things as requirement for watershed protection, type of soil, need for building up the range, etc. are of prime importance in determining the extent to which ranges should be utilized. For example: Usually weed species may be grazed quite heavily after they are mature without injury, but perhaps not more than 70 per cent of the volume of blue bunch wheat grass should be taken by the end of the season. Some soils are much more subject to erosion than others, and therefore need more protection. For these and other reasons the extent to which units of range may be utilized must be decided for each unit on the ground, but in no case should it be planned to utilize the forage more than an average of 80 per cent.

Much more study is needed to determine how fully species and types of plants may be utilized without injuring the vigor of the plants.

(PART IV)

FOREST MANAGEMENT SECTION

(Prepared by Forest Management)

In considering the progress being made in investigative work along Forest Management lines in District 4, it is well to keep in mind the fact that we have no funds set aside for that specific purpose either for salaries or for expenses. Such progress as we are able to make is the result of contributions of time and expense from our regular duties and G.E. allotments.

Such a method has certain disadvantages and some advantages. In the first place the work is being done quite largely by the local forest organizations and it goes without saying that the quality of work and thoroughness of the studies must lack considerable from that carried on by men experienced in research work and directed by Station chiefs who are able to give the subject very full consideration and close supervision. On the other hand, value as a means of training and in bringing about a full appreciation of the value of reseach work is enhanced.

The work during the past year was along seven lines.

1. Mc - The establishment of permanent plots to determine the rate of growth after cutting in mature stands under present marking methods.

2. Mt - The establishment of permanent plots to determine the effect of various degrees of thinning on rate of growth in immature stands, particularly in lodgepole pine.

3. The establishment of closed and open plots to determine the effect of grazing by sheep and cattle on reproduction. Largely a Utah project in yellow pine and spruce type.

4. A study of increment by individual trees and stands in old cut-over areas to assist in growth predictions in management plan preparation.

5. A study of rate of growth of reasonably well spaced dominant and codominant trees in virgin stands to assist in growth predictions in management plan preparation.

6. The accurate measurement of additional trees for the extension of our present site table to cover the entire district.

7. A limited amount of experimental reforestation work to determine the feasibility of planting on selected sites.

A total of 83 permanent sample plots in the various projects have been established to date.

1. Mc - Methods of Cutting. This designation is somewhat of a misnomer. All of our plots are established to determine growth after cutting under standard Forest Service marking rather than to bring out comparisons between various methods of marking. The plots have a minimum of 75 trees; all trees are tagged. D.B.H. was taken with a tape, height with an Abney level and trees are classified as to crown. The plots have permanent corners and are tied either to land corners or permanent landmarks. It is believed that ultimately we will be able to construct an empirical yield table for cut-over stands for the various sites and for different degrees of stocking after cutting.

Yellow Pine Type: We now have in the District 35 plots, 24 of which have been cut over. The other 11 are plots established on the Payette and Weiser Forests where cutting was discontinued before the plots were reached. Of the 24 cut-over plots, 17 were reported this year. Four of the plots are old ones which were reexamined the second time last year; one on the Salmon National Forest and three on the Payette. The average net growth per acre on the four plots for the first 12 years after cutting was 180 board feet with an initial leave varying from 1539 board feet to 5800 board feet per acre. Net growth varied from 99 board feet on the plot with an initial leave of 1539 board feet to 278 for one with 4873 board feet initial leave. The plot with the largest leave was on the Salmon Forest and only the most decadent trees were removed. This plot showed 180 net annual increment as did also the average of the four plots. Averaging the three Payette plots shows an average leave of 2935 board feet and an average net annual increment of 189 board feet per acre per year. The average annual loss through trees dying was 23 board feet per acre per year. These plots are now what we call our Site II yellow pine. The data to date indicate a better productivity than we have been inclined to credit our granite soils. One of the outstanding leads obtained to date is the effect of proper spacing on rate of growth. Comparison of growth of trees left in clumps with those with full light and corresponding ground surface for soil moisture indicates plainly that our annual growth per acre would have been much more satisfactory. Actually greater had we resorted to thinning of these clumps.

Lodgepole Pine Type: We now have 15 permanent plots in the mature lodgepole pine type. Six were established or reported this year. None of these plots have stood long enough to give data on what we may expect. At least six of these plots are in stands over 160 years old and will ultimately offer some answer to the question as to what we may expect where overmature lodgepole is cut over for ties with no market for smaller material.

Engelmann Spruce Type: There are three plots in this type; two established this year and one last. No conclusions are yet possible.

Douglas Fir Type: One plot was established this year.

2. Mt - Thinning in Immature Stands. Considerable progress was made on this study during the year. We now have 19 such plots in lodgepole and two in Douglas fir. The oldest plots are seven years old. This is a set of three plots as follows: one thinned from above, one thinned from below and one check plot. These three plots were remeasured this year and while the data have not been fully analyzed some conclusions are noted. The stand was about 150 years old at time of thinning and has been so far overstocked that few trees over 10" D.B.H. were present. Also there was considerable mistletoe infestation. The remeasurement shows that these plots have not made any satisfactory response to thinning. Growth on all three plots has been very slow and there is no worth while difference between the thinned and unthinned plots. Quite probably the stand had stood too long in an overcrowded condition to make thinning worthwhile.

A lot of work in thinning young stands to various degrees is being done on some of our lodgepole forests notably the Targhee and Minidoka. Both forests have in mind and have started on quite a complete study of the effect of thinning in different aged stands on different sites. Necessarily progress in establishing plots will be slow as the amount of time available for the work is dependent on what can be spared from administrative duties.

3. Mr - Effect of Grazing on Reproduction. It has been felt for some time that we do not have a very clear idea of the extent to which reproduction is damaged by grazing, particularly in Utah. In some instances we are inclined to blame everything to grazing and in other instances we are inclined to whitewash grazing and place the blame on causes other than grazing. With the idea in mind of getting a more satisfactory answer and at the same time encouraging and directing more intelligent general observation, we are stressing this feature particularly in Utah.

In connection with the deer situation on the Kaibab 26 plots have been established. A part of these plots are for the purpose of determining the effect of deer grazing on coniferous reproduction. However, this project is handled as a game study.

The study to determine the effect of grazing of domestic stock on reproduction is just getting under way. We have eight pairs of plots established. Each pair consists of an enclosed plot with an outside check plot.

4. Growth in Cut-over Stands. Junior Forester Bert Lexen spent approximately a month last spring prior to his transfer to District 3 in a study of growth on an area in yellow pine type cut over 38 years ago on Mann Creek on the Weiser Forest. All of the trees on 12 one-acre plots were bored with an increment borer and data as to rate of growth before and after cutting recorded. The

data indicates a rather constant radial growth regardless of diameter of the trees, although black jacks were superior to yellow pine. A total of 370 trees were studied. A preliminary report on this project has been submitted by Lexen with a promise of a more detailed report as soon as the necessary time becomes available.

Junior Forester Clark Miles of the Payette Forest made a similar study on old cuttings (up to 60 years old) on the Payette Forest. Some 500 individual trees were studied. His findings have been prepared in the rough but will be worked over thoroughly before being submitted.

Some additional work on old cuttings was done on the old Michigan white pine sale on the Boise Forest. This area was lightly cut over about 19 years ago. The outstanding fact here was the acceleration shown in nearly every tree examined and the fact that release was noticeable where a tree had been removed as far as 80 feet from the one examined. This may probably be due to the longer growing season caused by opening up the stand on a south slope.

5. Growth in Virgin Stands. Work along this line was done largely by the timber survey crews as a part of their regular job. A large number of reasonably well-spaced dominant and codominant trees of all sizes were bored for total age and rate of growth during the past 10 years. These data are usable as a makeshift in predicting growth in present management plan work. It ignores acceleration after cutting but it also does not include trees of the type which would not be released by cutting. Hence it may give fairly reliable data with which to step up stand tables for cut-over stands. In any event it is a lot better than a guess at what growth figure we are safe in using in our plan work.

6. Site Study. Last winter a regional site table was prepared from several thousand height and diameter measurements which had been collected during the previous three seasons. Height on D.B.H. site tables were prepared for all species. Unfortunately almost no measurements were available from the south half of the District. This summer sufficient measurements were recorded in the south half of the District to make possible a revision of the table to include the whole District. The data will be worked up this winter. In all probability the final table will base site on height and D.B.H. up to maturity and on total height alone for mature stands. An effort will be made to correlate the data with the tables used in Districts 5 and 6.

7. Reforestation. Four thousand trees were planted in an experimental way in selected sites on the Fishlake and Manti Forests. Stock was secured from the Pike and Savenac nurseries. The reports this fall show a very high per cent survival.

Plans for 1928

The outlook for administrative studies during the coming year is good. It is believed that considerably more progress will be made this year than last. This is particularly true as regards growth plots in mature stands, thinning plots in immature stands and plots for studying the effect of grazing on reproduction. Our rangers generally are keenly alive to the need for such work and are anxious to assist in the project as fast as the methods can be demonstrated to them on the ground.

Based on work plans submitted we are safe in expecting around 35 additional Mc plots, 20 additional Mt plots and 20 Mr plots. The progress here, is, of course, dependent on the character of season but under normal conditions we should make that amount of progress.

One forest will make a start to determine the rate of spread of mistletoe to reproduction under infected stands.

The Payette Forest, in cooperation with the University of Idaho, has projected a study of defect in white fir which may be of real value in future white fir marking. The study has in mind the determination of the relation of external characteristic of the tree to the amount of defect found after fellings. Marking in white fir has been a real problem in many cases because of the inability of the marker to decide which trees were unmerchantable and which were not.

In discussing the above work it must be kept in mind that to a very large extent the projects have been carried through by our ranger force directed by technical men where possible. We would not argue that the work compares in quality with that done by the stations. Probably the biggest single result of the whole activity will be the training of our field force, the insight it gives them on the fundamental purposes back of our work in silviculture and the possibilities of close observation. No one thing we have attempted has stimulated so much interest in Forest Management as has this semi-research work by the local force. This training, together with the valuable data which we will ultimately get from the work, make the activity one of real worth to the District.

(PART V)

INVESTIGATIONS IN FISH AND GAME WORK

(Prepared by S. B. Locke)

Studies in connection with the administration of the Grand Canyon National Game Preserve have been carried out along several lines.

Cooperating with the Bureau of Animal Industry attention has been given to the problem of losses in rearing fawns and in handling those which were trapped. Considerable time was spent by Dr. W. T. Huffman, of the Bureau of Animal Industry, with the individuals rearing fawns and at the deer traps. Although there are still problems in feeding to be studied, considerable success has been had in determining proper foods. These have been covered in separate reports.

This year 115 hand-raised fawns were shipped. Trapping was not carried out extensively but 23 fawns being shipped. These were held in pens for as long as six weeks to study proper foods and handling. Considerable information was obtained, indicating that such operations were practical at least for shipments to nearby points.

A comprehensive study has been undertaken of the relation of deer grazing to tree reproduction and forage plants on the Kaibab Forest. In connection with this there have been established in the various types fourteen fenced enclosures, twenty-six quadrats and twenty-six sample plots. General observations on plant development and recovery were made in connection with enclosures completed prior to 1927 and photographs made of plots. As an example of results in the spruce fir type on the summer range is the following: One enclosure examined on September 9, 1927, showed 155 spruce and fir seedlings, 2" high, and 12 aspen seedlings below 6" high. On an outside check plot were 20 spruce and fir seedlings less than 6" high and 2 aspen seedlings about 2" high, all in poor condition through cropping by deer. It is planned to construct about 25 more enclosures early in 1928.

The work plan contemplates continued studies of the life history of deer and the effect of conditions here on the development and habits of the deer. Along with the effect of deer grazing on forage and tree reproduction, a number of stomach studies of deer are being made. These give an excellent indication of the forage plants taken and the relative quantity of each consumed under the conditions existing there.

The small amount of time available has been given to developing cooperative studies of water ecology particularly as effecting fish foods and the productivity of water areas. The October "Ecology" contained a paper by Hildebrant and Tower on "The Food of Trout in Fish Lake, Utah," based on a cooperative study there. Assistance was given Mr. H. B. Holmes, Junior Aquatic Biologist, of the Bureau of Fisheries, in the studies of the life history of salmon in Idaho. It is expected that this year by the cooperation of the State Fish Commissioner, Bureau of Fisheries and Forest Service, fresh water smelt from Maine will be introduced in lakes on the Challis and Sawtooth Forests to improve food conditions for trout. It is proposed to gather data which will serve as a basis of a study of the ecological effect of this introduction.

Although it is impossible to attempt elaborate investigations in this field, it seems the Forest Service should bring to the attention of cooperating agencies the need of such studies and possible fields of work. It may be possible with the assistance of such cooperation to use our field men to carry out current observations when studies are once initiated.

Another study well worth contemplating is the value of introducing beaver on badly eroded streams to check such erosion and help conserve the water supply. It is proposed that a number of beaver be introduced on the Ephraim Canyon watershed on which the Great Basin Experiment Station is located. Once the animals are introduced, the essential observations could be made by the Station personnel without any extensive requirement of time.

(PART VI)

SUMMARY OF RECOMMENDATIONS OF THE INVESTIGATIVE COMMITTEE

The District Investigative Committee meeting was held on February 27, 28 and 29, 1928. The following were in attendance:

R. H. Rutledge	District Forester, Chairman
C. L. Forsling	Great Basin Exp. Station
C. B. Morse	Forest Management
L. F. Watts	" "
E. Winkler	Range Management
J. O. Stewart	" "
A. R. Standing	" "
C. N. Woods	Operation
R. E. Gery	Lands
S. B. Locke	Fish and Game
Dana Parkinson	Public Relations
E. C. Sanford	Supervisor, Caribou N. F.
S. S. Stewart	" Minidoka N. F.
J. W. Farrell	Asst. Supervisor, Idaho N. F.
W. A. Denecke	U. S. Sheep Experiment Station
W. D. Candland	Utah Wool Growers
H. M. Harvey	Pres. Utah Wool Growers
J. M. Hooper	Secy. " " "

Herewith follows a summary of the recommendations and action of the committee.

1. Advisory Council

The organization of an advisory council to the Great Basin Experiment Station, composed of representatives of the stockmen, water users, State Experiment Stations and such other interests as may seem advisable, for the purpose of advising with the Station on the character of the work to be done and to further acquaint the various interests with the work under way, conditions that must be met in doing research work, the value of and need for research work and to induce the application of results has been under consideration for some time. It was brought up again this year and received the approval of the sheepmen present. The sheepmen suggested the designation on this committee of the grazing committee of the Utah Woolgrowers Association consisting of W. D. Candland, Sam Jorgenson and M. A. Smith. Recommendations were approved for proceeding further with the selection of this committee during 1928 with the possibility of their formal appointment in 1929.

2. Progress Reports

The present status of analysis of results and preparation of reports and publications was regarded as serious. The only suggestion that the Station could make, namely to reduce the field work as far as possible and devote this time to analysis of results, was approved.

The matter of making results of both the Station and administrative projects available for forest administration and the public as early as possible after they were obtained and not wait until the final details of a project had been worked out, was discussed at some length. There is grave danger of discrediting research by premature issuance of results that may lead to erroneous conclusions. On the other hand, there is equal chance of research receiving discredit by not making known the progress being made for such silence may seem to indicate lack of accomplishment. It was concluded that useful information should be made known as early as possible without waiting for final completion of a study, but with adequate safeguard and the distinct understanding that they should not be incorporated with major policies until adequate trial had definitely proven their value. Such a plan will be of value to research in affording trial of results that will divulge weaknesses before final conclusions are reached and of value in the practice of range management in affording at least a guide in problems where little or no information exists at the present time.

The committee also directed that the reports on administrative projects be mimeographed and distributed to the field along with the Station report.

3. Artificial Reseeding

Such phases of artificial reseeding as have passed the experimental stage should be placed on a test basis by forest administration, interested stockmen and the extension service. If possible a small amount of money should be made available for purchase of seed of such species as common brome, Kentucky bluegrass, Canadian bluegrass, slender wheat grass, mountain brome and the sweet clovers for use by forest officers and interested cooperators for test trials. Instructions should be prepared for making these tests, with regard to selection of site, amount of seed and time to sow, methods of treatment and grazing during period of establishment of the stand.

4. Utilization

The standards of utilization as arrived at in the meeting will be published in the District Range Management Handbook with explanations as to their use. The Station will prepare a memorandum report on methods of estimating utilization as have been worked out to date which will be distributed for limited trial and study in the field.

5. Ranger Quadrats

The instructions for locating and establishing ranger quadrats should be modified to give a more clear understanding of selection of areas for quadrats. The method should be continued until given a thorough trial. The program for the number of quadrats to establish should be reviewed and modified if necessary in order to keep the amount of work within reasonable bounds.

Ranger quadrats may be supplemented with studies of particular species by staking and keeping records of the number of plants on major plots.

6. The entire forest management investigative program was approved as presented.

7. Correlation of Administrative Projects and Forest Research

When a forest experiment station is established in the region the aim will be to still continue the administrative forest management studies by the administrative field force although the work will be correlated with the program of the station.

8. Experimental Forests

Although there is no forest experiment station in the intermountain region at this time, foresight should be taken in present and future cutting operations to reserve desirable areas for experimental forests in anticipation of the establishment of a station in order that the best sites will not be ruined before a research program is formulated. Such areas will eventually be needed to embrace the western yellow pine, Douglas fir and lodgepole types. Extensive virgin stands of these species still exist in southern Idaho, although the most suitable, especially the most accessible areas may be becoming limited. Consideration will be given by Forest Management to the reviewing of desirable areas in future timber sales and more definite action to select the areas will be taken when a forest experiment station has been authorized for the region.

9. Forest Utilization

Thought and study should be given by the administrative force, pending more complete study, to the development of more extensive use of and market for forest materials not ordinarily used at the present time. A more extensive use should be made for example, of local species such as lodgepole for poles and posts. There are two possibilities in view. One is that of eventually developing the practice by the Forest Service, either thru cooperative effort or direct action, of conducting the woods operations for certain classes of material and selling the cut timber rather than making the ordinary timber sale. The other

is further tests, demonstrations and education of the public in the preservative treatment and use of local species for posts, poles and other products.

10. Forest Wild Life Studies

An outline of the needs of the region in the way of studies and action to control game, rodents and other forest wild life in the Intermountain region will be prepared for presentation to the Biological Survey.